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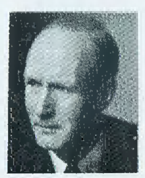
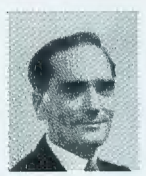


SIR CHRISTOPHER HINTON, *who is head of the Industrial Group of the Atomic Energy Authority, started life as an apprentice at Swindon railway works. After winning a scholarship to Cambridge he joined I.C.I. and became chief engineer of Alkali Division at the age of 29. He was seconded to the Ministry of Supply during the war and took over the industrial side of the atomic project in 1946.*



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Atomic Energy Explained

By Sir Christopher Hinton, F.R.S.

Electricity from Britain's first nuclear power station at Calder Hall is now being fed to houses and factories, and by 1965 a dozen or more of these stations will be working. The man responsible for harnessing nuclear energy to Britain's industrial needs explains here in simple language the principles involved.

To understand how atomic energy—or, to give it the correct name, nuclear energy—is produced, we must first consider what atoms are like. Scientists nowadays look on the atom as a miniature solar system. At the centre, corresponding to the sun, is the nucleus, containing two kinds of particles, protons and neutrons. These have the same weight, but while the protons have a positive electric charge the neutrons have no charge.

Circling round the nucleus, corresponding to the planets, are electrons, which have practically no mass, but carry a negative electric charge equal in amount to that on the proton.

In a normal atom the number of protons equals the number of electrons, and this number determines the chemical properties of the atom. Two atoms with the same number of protons but different numbers of neutrons behave in the same way chemically, that is they both belong to the same element, but they have different weights, and are called isotopes. Many of the ordinary, familiar elements are mixtures of atoms of different weights; iron, for instance, has four isotopes, while tin has ten.

Because an atom contains particles moving at high speeds and carrying electric charges, it possesses a certain amount of energy, and when a group of atoms is linked together to form a molecule the amount of energy of each atom is affected by the linkages. When a chemical reaction takes place these groups are rearranged, and sometimes the final grouping contains less energy than the original. When this happens the surplus energy is released as heat. Everyday examples of this are the burning of coal in the fire and the burning of petrol in a motor-car engine.

In these chemical reactions, the changes in the arrangement of the atomic particles affect only the electrons, and the change in energy is not very large. It is possible, however, to regroup the particles in the nucleus of the atoms, and in some cases the nuclei we finish with contain less energy than those with which we started. Again the surplus energy is released, but in these cases it is often very much greater than the release from a chemical reaction. In fact, the energy released is sometimes millions of times more, per atom, than in a chemical reaction.

Unfortunately, most of those nuclear reactions which release energy only take place at very high temperatures—something over one million degrees centigrade—which makes it very difficult to make them work under earthly conditions, though they are, of course, going on all the time in the sun and the stars.

There is, however, one important exception, and that is the nuclear reaction which the scientists call "neutron-induced fission." This takes place at ordinary temperatures, but there is only one atom existing in nature which is subject to it, and that is one of the isotopes of uranium with a mass of 235 units; its nucleus contains 92 protons and 143 neutrons.

When the nucleus of one of these atoms is struck by a neutron it splits into two smaller nuclei which have less energy than the original nucleus of uranium 235; the surplus energy is given off as heat and, most important, more neutrons are shot out of the atom as it breaks up. The number of neutrons is usually two or three, and they set off at very high speeds. The electrons from the original uranium atom arrange themselves round the two new nuclei, and so we have two new atoms which are called fission products; these are very radioactive.

Slowing down the Neutrons

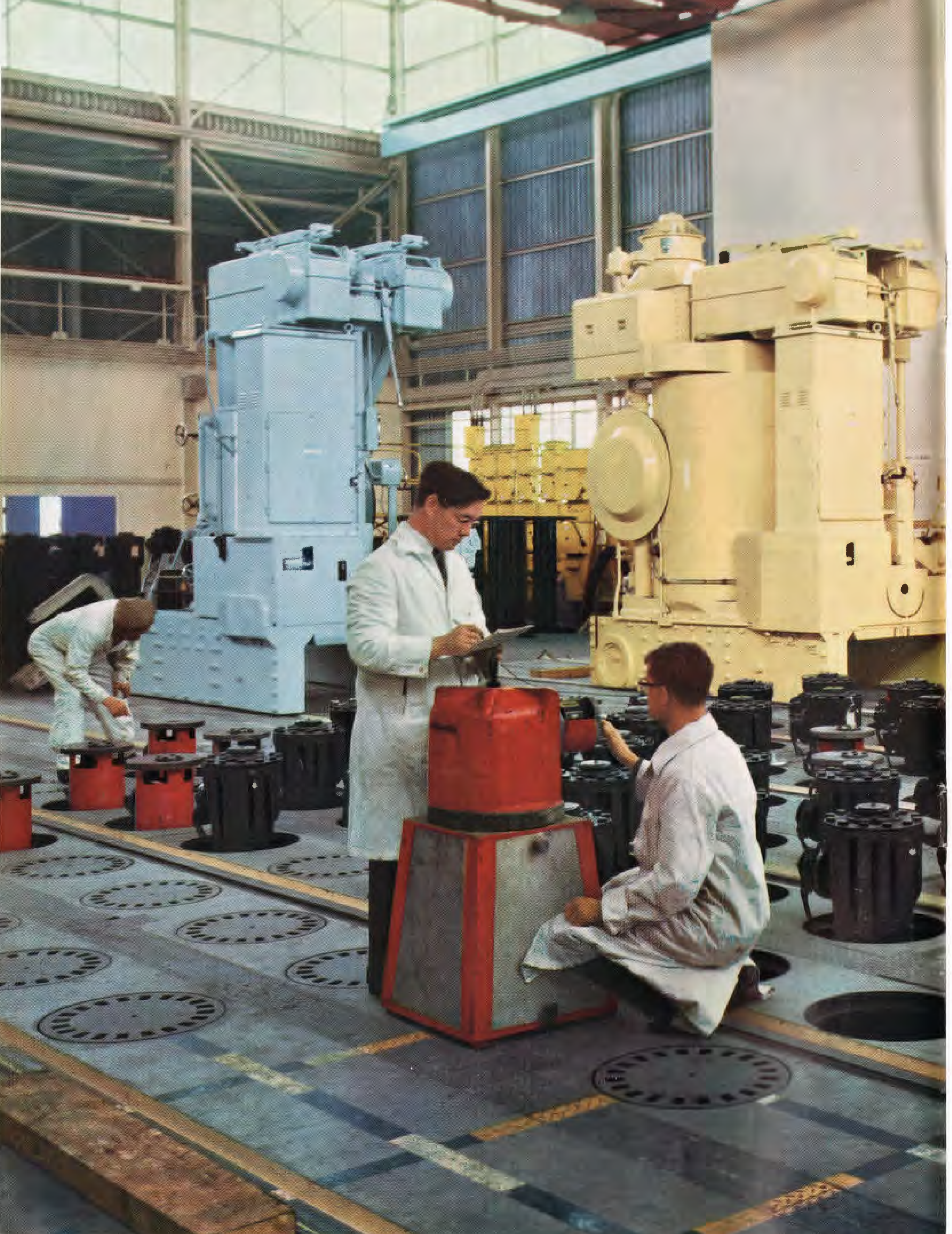
Clearly, if we can make one of the new neutrons strike another atom of uranium 235 we shall get a further fission, with more heat and more neutrons. By continuing the process we get a chain reaction, producing heat continuously.

However, natural uranium (that is, uranium as we get it from the ore) only contains one atom of this kind in every 140; the rest are almost entirely atoms of mass 238, and these are not fissionable. Consequently in a lump of natural uranium we cannot make this fission reaction carry on, because too many of the neutrons will strike the uranium 238 atoms. When this happens they are absorbed by the nucleus, which shortly afterwards gives off an electron, thereby changing itself to a new element which is not found in nature, called neptunium.

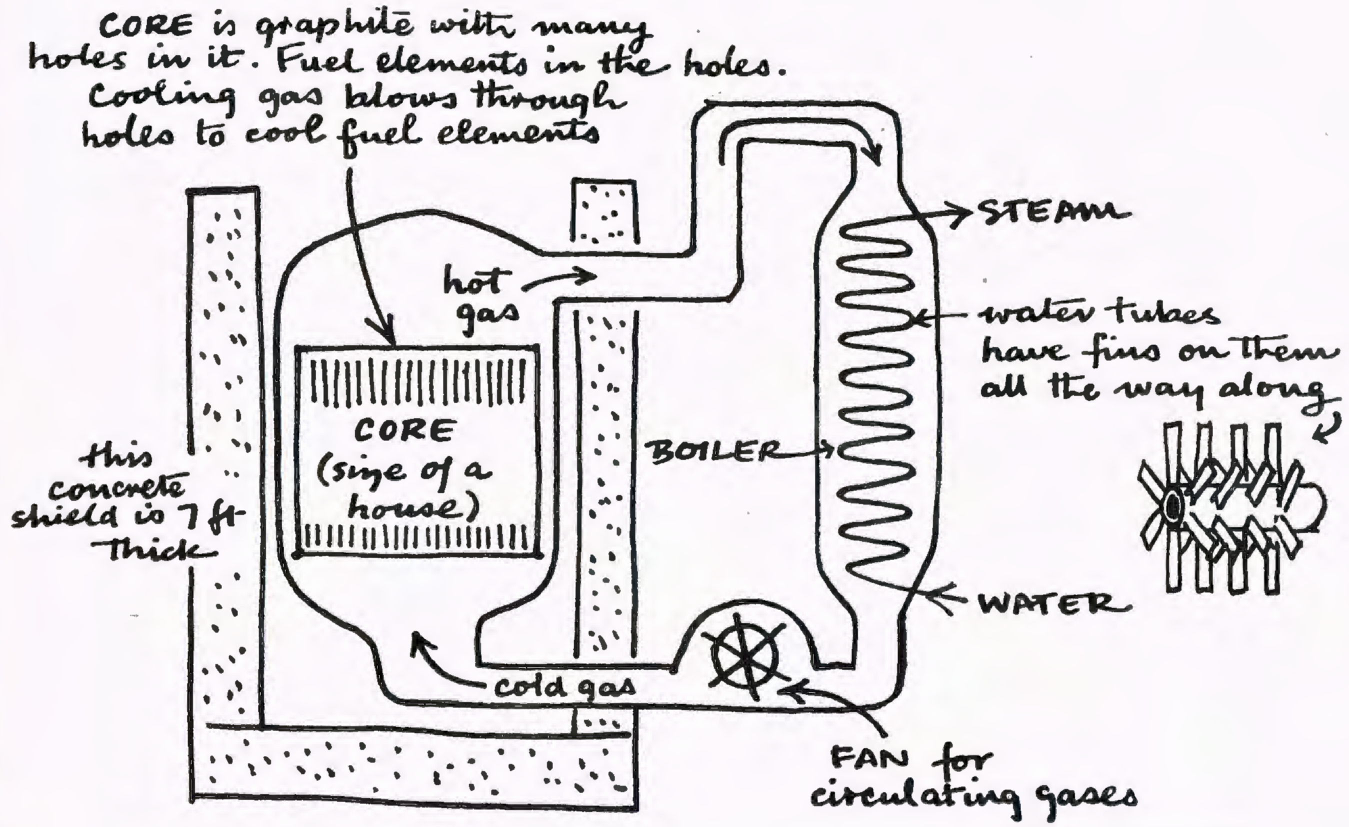
Neptunium in its turn gives off an electron and so converts itself into a second artificial element called plutonium, and plutonium is fissionable like uranium 235. Also, since plutonium is a different element from uranium, we can separate them chemically, and the first task of the Atomic Energy Organisation was to produce this pure fissionable material for military purposes.

In order to make plutonium, however, we have to keep up the supply of neutrons, and to do this we must ensure that of the two or three neutrons produced as each uranium 235 atom is split, one of them causes a further fission in another uranium 235 atom.

Fortunately, if we can slow down a neutron sufficiently it is much more likely to cause fission in a



Charge and discharge deck *of No.* I *reactor at Calder Hall. The technicians are standing on top of the concrete-enclosed reactor. The fuel elements are loaded into the reactor through the holes.*



By courtesy of The New Scientist

Sketch showing how *the Calder Hall type reactor (nicknamed Pippa) works. Heat generated in the reactor core is carried away by carbon dioxide gas. The hot gas is used to raise steam which can be made to drive a turbine.*

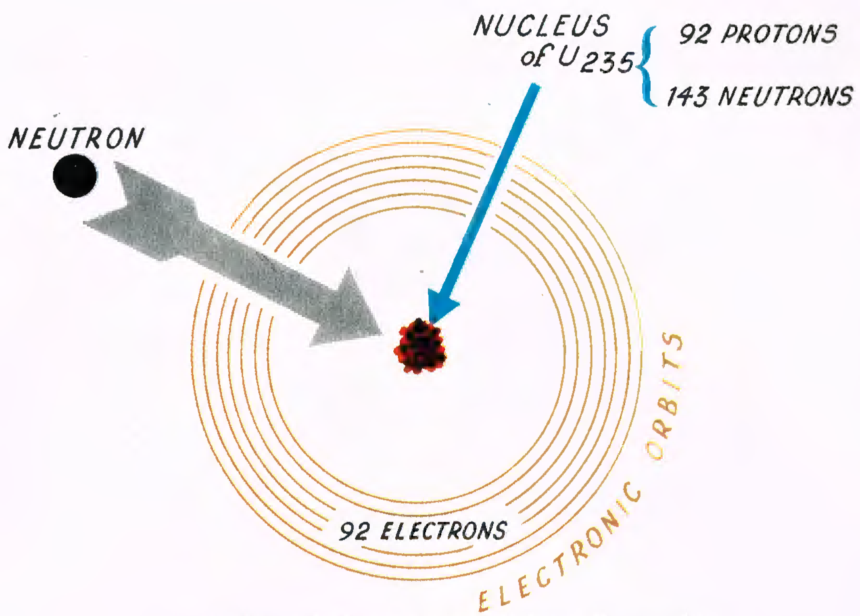
uranium 235 atom than to be captured by a uranium 238 atom, and we achieve this slowing down by allowing the neutrons to bounce about among other atoms of a substance which is very unlikely to capture them. This gradually reduces their speed until it is about the same as that which the surrounding atoms have because of their temperature, and for this reason they are then called thermal neutrons. Because it moderates the speed of the neutrons, this substance is called a moderator.

We have now arrived at a means of carrying on the chain reaction, and the device in which we do this is called a nuclear reactor, or pile. A reactor which uses thermal neutrons is called a thermal reactor. It consists of lumps of uranium surrounded by a moderator, and in the reactors we have built the moderator has been very pure graphite. Another suitable moderator is heavy water, and even ordinary water can be used.

In the atomic pile two reactions are taking place. Atoms of uranium 235 are being struck by neutrons, splitting and producing heat and on the average about $2\frac{1}{2}$ new neutrons. One of these carries on the fission reaction, and those of the rest which are not lost, either by escaping from the reactor or by being picked up by impurities, are converting uranium 238 atoms to plutonium.

Unless the reactor is more than a certain size, called the critical size, so many neutrons will escape that it will be impossible to maintain the chain reaction and the reactor will not work. In fact the reactor is always made bigger than the critical size because the reaction gradually dies away as the atoms of uranium 235 get used up. When the reactor is new the extra neutrons are absorbed by pushing into the reactor rods, which contain a substance such as boron which readily absorbs neutrons. When the reaction begins to die down these rods are gradually pulled out.

In addition we must have a safety device, like the safety valve on a boiler, and this consists of more of these rods of absorbing material which will, in an emergency, drop into the reactor immediately and shut it down.



Immediately before *a neutron strikes a* U_{235} *nucleus*

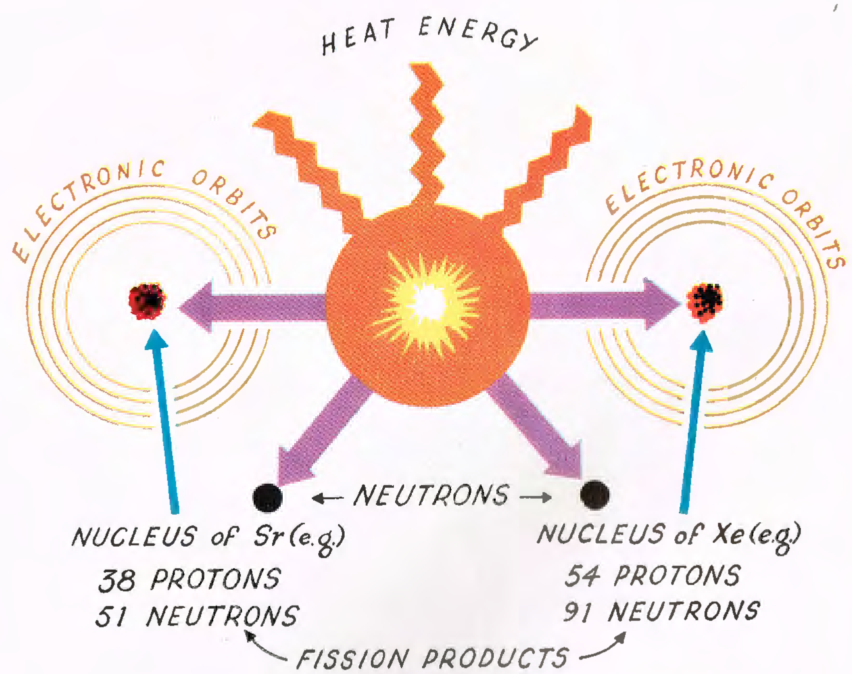
It will be clear that the first need of an atomic energy project, whether its objective is to produce material for military purposes or to use this new source of energy for peaceful applications, is a supply of uranium, and the first plant to be built by the Atomic Energy Organisation on its formation in 1946 was designed to extract uranium from its ore, convert it to pure metal and make it up into a suitable form for use as fuel in a reactor.

So far we have used uranium in the form of bars about an inch in diameter sealed into aluminium or magnesium alloy cans. These cans are partly to prevent oxidation of the uranium and partly to prevent the radioactive fission products from escaping.

The first large-scale reactors were built at Windscale in Cumberland to produce plutonium, and the heat produced in them is wasted, because when they were designed there was insufficient engineering knowledge to enable the reactor to work at a high enough temperature for the heat to be used to produce power. These reactors are very big, each weighing over 50,000 tons; the graphite moderator, built up of thousands of bricks, is 50 feet high and is completely encased in a concrete box over eight feet thick. The purpose of this is to reduce the level of radioactivity escaping from the reactor core enough to make it harmless to the operators outside, and for this reason it is called a biological shield.

Radioactivity is rather like sunlight—the human body is exposed to both and can withstand a certain amount of either without suffering harm. A larger dose, particularly if it is concentrated, makes us ill, and sufficient can cause death. The reactor is cooled by blowing about a ton of air through it every second. This warm air is discharged, after filtering, through chimneys 400 feet high.

After being in the reactor for some months the fuel elements are removed and processed to extract the plutonium. Because they are extremely radioactive this must be done by remote operation in a chemical plant which is also surrounded by a concrete biological shield, and it must be remembered that the plutonium is only present as less than a thousandth part of the material.



Immediately after *the neutron strike. There are now two new nuclei, surplus energy is given off as heat, and there are other neutrons to provide a chain reaction.*

Even while these Windscale reactors were being built, designers were considering how to raise the temperature of the reactor so that the heat produced could be used instead of coal or oil for steam raising in an electricity generating station, and their efforts were so successful that in 1953 we were able to start building the first nuclear power station at Calder Hall, alongside the Windscale factory. The reactors here are cooled by carbon dioxide under pressure, and this hot gas is then used to produce steam in heat exchangers or boilers. Having given up much of its heat it is then pumped back through the reactor on a closed cycle. The steam drives turbo-alternators and produces electricity just as in a conventional power station.

When both Calder Hall stations are complete they will have an installed generating capacity of 184,000 kilowatts, enough for the domestic needs of a city of a million people.

The Fast Reactor

In February 1955 the Government published its plans for the development of nuclear power stations to help to meet the ever-growing demands for electricity and to overcome the increasing difficulty of supplying these from the use of conventional fuels. Our present annual usage of fuel for power stations is equal to about 40 million tons of coal, and it is estimated that by 1975 this will have risen to the equivalent of 100 million tons. At present nearly all the fuel is coal, but for much of the expansion we should have to rely on imports of oil. An alternative was urgently needed, and it was considered that by relying in the early stages on reactors similar to those at Calder Hall a start could be made next year. By 1965 it was planned to have twelve stations in operation, generating about 2,000,000 kilowatts, but it seems possible that this programme will be materially increased.

Besides the heat which they develop, all these reactors will be producing plutonium, which it will be recalled is a pure nuclear fuel and can be used in certain types of reactor.

When concentrated fuel is used there is no need for a moderator, because there is not sufficient absorbing material mixed with the fuel to damp out the chain reaction. This has two advantages: it reduces the size, and consequently the cost, of the reactor, and fewer neutrons are wastefully absorbed. Because the neutrons are not slowed down a reactor of this type is called a fast reactor, and a prototype is being built at Dounreay, in the north of Scotland. Its core is only 2 feet in diameter and 2 feet high, but 60,000 kilowatts of heat are generated in it (a one-bar electric fire consumes 1 kilowatt).

Liquid Metal Cooling

Gas cannot be used to remove so much heat from such a small volume, and the reactor has to be cooled by means of liquid sodium, circulated by electromagnetic pumps. Also, with such a small core, if the liquid sodium stopped circulating the core would rapidly melt and some of the fission products might be vaporised. To prevent them from escaping and spreading radioactivity over the surrounding area the whole reactor is encased in a steel sphere 135 feet in diameter.

An important feature of this reactor is that the core can be surrounded by a blanket of uranium 238, which will absorb the neutrons escaping from the core, producing fresh plutonium. Also, because fewer neutrons are wastefully absorbed, the uranium 238 will capture so many that plutonium will be produced faster than it is used up in the core, and for that reason this type of reactor is called a breeder reactor.

The Challenge of the Future

There are other possible ways of using plutonium as a reactor fuel and many other possible types of reactor. For example, thermal reactors can be built using heavy water as moderator and/or coolant, or ordinary water may similarly be used. It is possible to have the fuel present in solution instead of in solid lumps, in what are called homogeneous reactors.

These and other problems present us with a tremendous challenge. In atomic energy there is an immense future, and the opening of Calder Hall was only one more step towards it.

Dog Handler

PERHAPS this should have been called "One Dog and His Job," for it is just as much about a handsome three-year-old Alsatian guard dog called Suki as it is about his handler, patrolman Bert Mather.

Bert and Suki work at the Randle Works of General Chemicals Division. Two years ago Bert was just one of the patrolmen on shift work, manning the gate by day and patrolling the factory at nights and week-ends. But after a string of burglaries at the factory the management felt it was time to tighten up security on the site.

And so Bert became a dog handler.

"Of course, it wasn't all plain sailing in the beginning," said Bert. "Suki was fully trained when we got him, but I'd never had a dog in my life before, so I had to start right from scratch and learn how to handle him."

For ten days they worked together under the supervision of an expert. Bert had to learn not only how to give the dog orders, but how to groom him, feed him, and keep him 100% fit. Suki learned to obey Bert's voice, and to obey it instantly.

"Obedience is ninety per cent of the battle," Bert told me. "You see, the dog's natural instinct is to attack a stranger. What I've got to make quite sure about is that Suki doesn't slip his chain and attack someone unless I order him to."

I saw his point. Works managers and other perfectly innocent people may be on the site at night and would not thank Bert if Suki—eighty pounds of bone and muscle (and teeth)—were to launch himself on them.

Patrolling starts at 5 p.m., when most of the plants shut down for the day. Bert collects the keys from the gateman, and then he and Suki start their rounds. Every half-hour he phones his position back to another member of the security force on duty in the control room. Bert concentrates on patrolling the perimeter fence while his mate checks up on the central part of the factory site. The actual route taken round the site depends on the prevailing wind. Downwind Suki will pick up a human scent up to 300 yards away. That is one point where the dogs differ from police dogs, Bert informed me. Kim and Suki have been specially trained to pick up a scent from the air; police dogs track a scent along the ground.

I asked Bert what the drill would be if Suki found an intruder.

"First thing is to warn the intruder to stand still," said Bert. "He's safe as long as he does that—Suki won't go for anyone unless I order him to or unless the chap attacks me."

Bob Pickering, one of the Randle processmen, can confirm the wisdom of standing still. One foggy morning he was walking to his job not far from where Suki was being exercised. Neither Bert nor Bob could see or hear each other, but the dog picked up the scent and trotted off to investigate. When the processman was suddenly confronted by Suki, he turned and ran for a nearby building. He just beat Suki to it.

Every month Bert and Suki undergo a refresher course on the site at the hands of an expert. It takes the form of a test, which includes obedience and criminal work. Perhaps the most impressive part of the test is to see Bert and his dog walking quietly along a road, then detecting and apprehending an "intruder" who has been carefully hidden. Needless to say, the "intruder" wears a special suit which incorporates much padding! At the most recent test Bert and Suki lost only 1½ marks.

Bert and Suki share guard duty on the 124-acre site with one other dog, Kim, and three other handlers.

Off duty, the dogs live in kennels built for them in the factory, and every morning the duty handler feeds them on hound meal and canteen scraps.

On the lighter side, Suki and Kim and their handlers have firmly established themselves as a prime attraction at local fêtes and carnivals, and recently Kim became Randle's first television celebrity when he appeared in a programme called "Dogs to the Rescue."

Since the dogs arrived at Randle burglars have discreetly given the factory a wide berth and it has not been necessary for Bert and Suki to put their training into serious practice. But they feel that when the time comes they will give a good account of themselves. A.E.B.

Bert Mather and Suki

Information Notes

REWARDS FOR RISK

By S. P. Chambers (a Deputy Chairman of I.C.I.)

Mr. S. P. Chambers, a Deputy Chairman of I.C.I., broadcast recently in the Third Programme on "The Conditions of Investment." In the course of his talk he touched on the question: What forecast return on capital is needed before expenditure on plant for a new product is undertaken?

GIVEN the best long-period forecasts which may be available for a particular new product (said Mr. Chambers), the question at once arises: What forecast return is needed before capital expenditure on plant for the new product will be undertaken?

The answer is not simple; it is not uniform for all cases. *If we are considering a business which is being financed mainly by ordinary share capital, the return must be at least high enough to pay a rate of dividend which the shareholders expect or could get from investing in a similar business.* Otherwise the money will not be forthcoming either from existing shareholders or from the general public through an issue on the stock and share markets.

In this country, to the gross dividend paid must be added the equivalent profits tax. The average yield on ordinary shares is about 7% today, which with profits tax amounts to 11%. After deducting income tax the shareholder receives about 4%. *Thus 11% profit must be earned on the capital to pay a 4% net dividend to the shareholders.*

Above the profit needed to pay dividends and profits tax, a margin is required to cover the cost of replacing plant and machinery during the present rather inflationary conditions. A further margin is needed to allow for the period of construction when no profits will be earned. This period may be anything from six months to six years or more if heavy constructional work or deep mining is involved.

A project which yields less than about 12½% profit on the capital employed would, for these reasons, generally be regarded as wholly unattractive and barely able to pay a reasonable dividend without any margin for reserves.

If it is safe to rely on fixed interest loans the interest cost will be substantially below the cost in dividends and profits tax of equity capital, but this form of finance is suitable only for products for which the demand and the prices are likely to be steady over a period of years. It is unsuitable as the main form of finance for the general run of products for which the demand may be fickle and the profit margin may disappear.

"*High proportion of turnover . . .*"

With many large businesses the money needed for new projects is found partly by loans and partly by share capital. To what extent is the management of such a business influenced by the current rate of interest in determining whether to go on with a project or abandon it? The answer is that where the period of construction is very long and a substantial part of the money needed is raised in the form of loan capital, this factor will be important and may be decisive. To pay 6% for perhaps ten years before any profit emerges is a burden which will kill a project that has the prospect of only a moderate profit when it is completed.

On the other hand, where the period of construction is short and where there is a prospect of high, if somewhat precarious, profits, the current rate of interest will be a negligible factor. If, for example, a profit of between 20 and 30% is in prospect, it does not matter much whether the interest is 4%, 5% or 6%. This will not be true in a country such as Brazil, where the minimum rate charged by a bank is 12% and where 24% or more must be paid for loan capital.

It would be fair to say that for most manufacturing industry in Britain today the current rate of interest has little bearing on decisions to spend capital on new factories or new plant and machinery. Other factors, including those arising from government policy, are of much greater significance.

Where there is a large element of risk the return must obviously be higher to make it worth while to erect the plant. A further risk must be considered if the plant is to be erected in a country where there is a serious danger of expropriation. Some governments, including some within the Commonwealth, expect foreign capital to enter their countries and to be used to erect factories, the products of which would be price-controlled so as to yield no more than about 5% on the capital employed. How unrealistic this is can be gathered from the figures already given of minimum profit needed to service the capital raised. When expropriation as a long-term threat is also present, no responsible board of directors can touch such a proposition unless there are other and less direct advantages to their business which outweigh the risks.

"*Danger of expropriation*"

For some new products the calculation of profit may be complicated because the rate of profit may be expected to be high for a short period while the product is novel and competition is almost non-existent, and then drop to a low figure and disappear altogether soon afterwards as newer and better products come on to the market. In others, the market may have to be nursed for some years, so that the early profits may be expected to be small or non-existent and the later profits to be higher.

In considering whether the capital expenditure necessary to manufacture a new product is worth while, the estimated rate of return on the capital invested is not the only factor to be taken into account. I have already referred to the impermanence of the markets for some products. In calculating what are the profits in such cases account must be taken of certain factors such as rapid obsolescence, or research expenditure not directly related to the products or processes but incurred in an attempt to discover better processes or products.

In the pharmaceutical industry, for example, a new drug may be an outstanding success for several years and then be superseded by one that is even better. For this reason in this industry research expenditure represents a high proportion of turnover. Much of this research expenditure will always prove to be abortive in the sense that it leads to no new products or processes and only here and there will there be a lucky strike which makes the research effort as a whole worth while. *Thus a margin of 50% over the manufacturing cost of a particular drug, before taking into account research expenditure as a whole, may be actually too low to justify maintaining the research expenditure necessary to keep up the manufacture of new drugs as the old ones fall by the wayside.*

It is on matters of this kind that fixed notions of what is a reasonable margin of profit on manufacturing cost or a reasonable return on capital expenditure can do so much harm if those notions lead to such restrictions of profit margins that insufficient is left to finance the research necessary to keep the industry alive. This is not an academic problem but a vital issue in which a popular but misconceived government policy could lead to stagnation in a British industry where American and German industry suffer no corresponding disability.

Although a high direct return on one type of product may be necessary to make continuance of research and manufacture within the field worth while, at the other extreme there are circumstances in which capital expenditure will be incurred for the manufacture of a product which is expected to yield little or no direct return at all.

"*Servicing the capital*"

First, there are the products which must be made together in the same factory if manufacture is to be economic. In some cases it is physically impossible to make one product without making another; in others it is far more economical, but not physically essential, to make a number—perhaps a large number—of products, as part of the same set of operations or as grouped operations.

This is true, for example, of the manufacture of certain types of dyestuffs. From a given set of raw materials, or from what would otherwise be the waste materials from other manufacture, it may be worth extracting additional products, even if the return on the capital needed to put in the additional plant or equipment appears to be low. It clearly pays to make the extra product if the additional profit from doing this is greater than the costs incurred, including servicing the capital.

WHO USES TITANIUM?

By Michael Clapham (Joint Managing Director, Metals Division)

Three years ago a contract was signed to build Britain's first full-scale titanium plant. That plant has already turned out over 1500 tons of titanium in a year. Who buys it? And what new uses are round the corner?

This article is part of a B.B.C. broadcast given recently by Mr. Clapham

THE other day I saw two lorries standing by a factory gate. One of them was carrying three tons of brass rod, going out to be stamped into plumbers' fittings. The second also had a three-ton load of rod; but this time it was titanium. I could not help wondering whether "metal of tomorrow" was the proper description of this ordinary-looking stuff which was going out by the ton today—going out to be cut up, forged, and shaped into tens of thousands of compressor blades for jet engines.

Then I stopped for a minute to work out what the loads in those two lorries were worth. The man who bought the brass rod would have paid about 2s. 3d. a pound; say £750 for the lot. The titanium rod would cost the buyer something like £5 a pound,* so that his lorry load was worth about £33,000. For the ordinary man, who does not buy jet engines, titanium is still in the "tomorrow" class.

But it is quite clear that titanium's tomorrow is coming round quickly. Ten years ago the metal was only a laboratory curiosity. Six years ago its possibilities had been recognised, but the production in the whole world did not add up to 50 tons. Three years ago a contract was signed to build the first full-scale plant in this country.

Today? Well, that plant turned out about 1500 tons in the past year. Some of those tons are flying in the R.A.F.'s fighters and bombers, with their Rolls-Royce Avon engines. More of them will be circling the world when next year's fleets of Bristol Britannias take the air. And designers of aircraft and engines are specifying different alloys of titanium in their appropriate places, just as they specify various steels and aluminium alloys.

It has been an astonishingly swift progress, this, from a handful of laboratory specimens to hundreds of tons of an engineering material in less than ten years. No other metal has ever passed through the early stages of technology so quickly. People sometimes compare titanium with aluminium; but it took fifty years to get aluminium to a similar stage. Obviously a lot of money—and, more important, a lot of technical effort—has been poured into developing titanium. What has it got to justify this expensive forcing?

Well, first of all it has a high strength to weight ratio: you can get titanium alloys in roughly the same range of strength as alloy steels but with half the weight. The importance of this property in aircraft is obvious: a modern four-engined aircraft with turbo-prop engines weighs about 40 tons, of which 10 tons are steel. You cannot in fact replace all the steel with titanium, because it has some limitations.

For example, its resistance to friction is poor: it tends to gall and weld itself to other metals, so that a moving part of titanium rubbing against anything else would quickly seize up unless protected, say, by chromium plating. Again, its creep properties are not outstanding: that is, if it is under stress at high temperatures it tends to elongate a little, permanently. The result is that while you can use titanium for the compressor blades of a gas turbine engine you cannot use it for the blades of the turbine itself, which runs much hotter.

Still, even with these limitations you could perhaps save up to two tons in a four-engined aircraft by simply replacing steel with titanium—and two tons is a very valuable pay-load.

The real economy, of course, does not come from simple replacement, but from designing aircraft and engines which really use titanium's properties to the full. You can see how the savings add up when the aircraft is so much lighter that it needs substantially less fuel, and so releases even more cargo space. It may be worth hundreds of pounds sterling to save a pound's weight in the structure.

Coming round quickly . . .

I have been talking as though high cost were a permanent feature of titanium. In fact there are good reasons for thinking that in the next three years or so the cost of titanium products will fall, perhaps to about half the present level. Even then it will not be cheap, but many new uses will open up for it.

An outstanding property of titanium, which will before long, I think, bring it into use in much wider fields, is its phenomenal resistance to corrosion. In a wide range of acids and alkalis titanium has a life many times that of present constructional materials. Indeed, it is difficult to talk about this property of titanium, since it has not yet been in use long enough for its life in most of the possible applications to be known.

As you would expect, the first uses have been found in chemical works, where the length of time a plant can run is often governed by the life of the constructional material. For example, one plant had to be closed down every three or four months to replace the valve plates in a gas compressor line, which were made of alloy steel. They have been replaced by titanium, which appears to be as good as new at the end of three months. It cost perhaps £20 to £30 to put in the titanium; but the cost of closing the plant is measured in thousands of pounds each time.

That is only one application. Others are being found in tanks and vessels for acid production, particularly in places where the material would be contaminated by corrosion products, and in ducts for acid fumes, in fans, and in various types of heat exchanger. The list will grow as engineers realise that a new structural material makes new processes possible.

A particular aspect of titanium's corrosion resistance is that it withstands seawater in a way that you can only call astounding: it has been estimated that it would take 4000 years in seawater to corrode away the thickness of a postage stamp.

Mind you, there are other metals with a good resistance to seawater: for example, condenser tubes in ships and in power stations on the coast are generally made of cupro-nickel or aluminium brass, both of which give good service in clean seawater. But in some polluted harbours and estuaries even these metals may corrode quickly: there is a power station in the Caribbean where the tubes last barely two years, and in some British stations their life may be less than four. One of these stations put in an experimental batch of titanium condenser tubes recently.

Since the shortage of adequate supplies of clean cooling water is already affecting the siting of our new power stations, the ability to use heavily polluted sources may be of great economic importance.

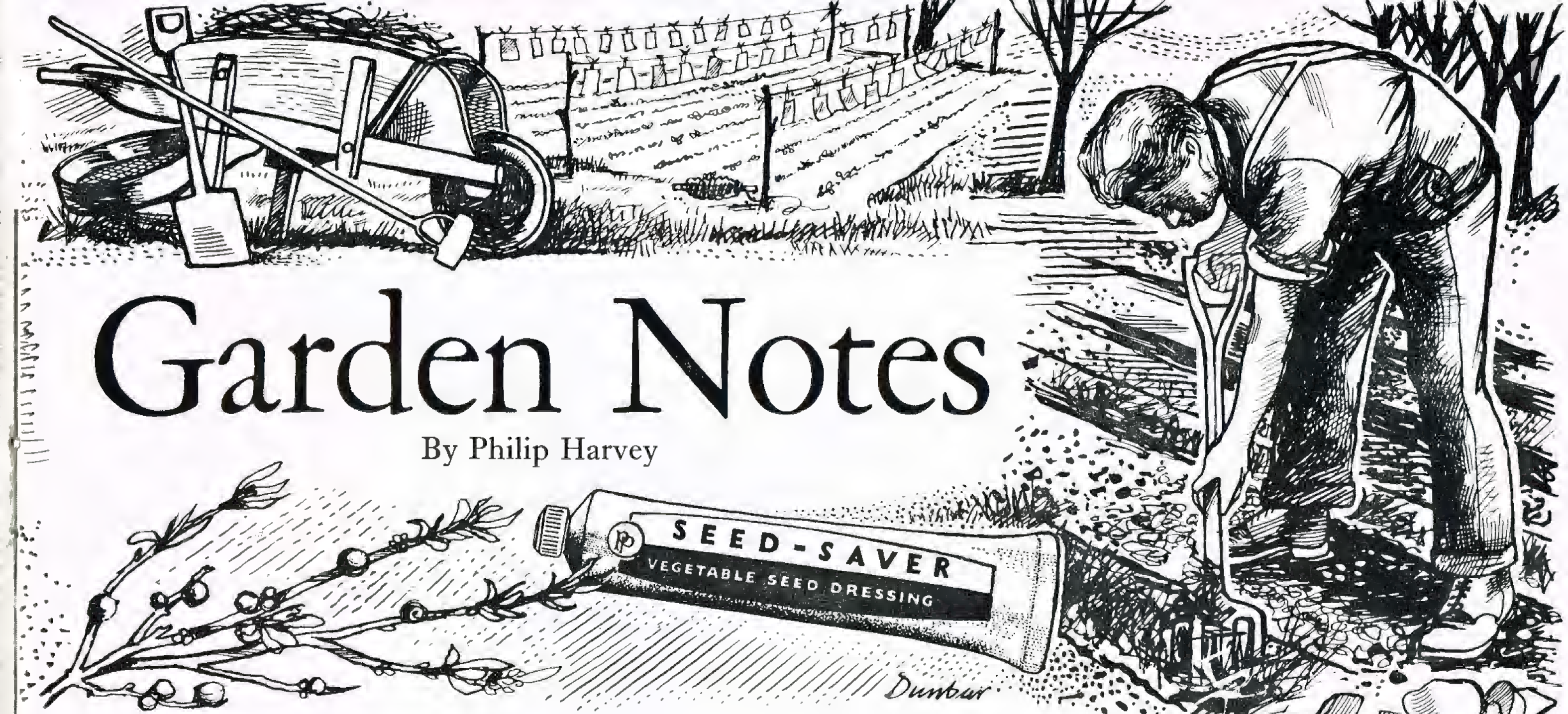
In ships, too, uses for titanium are bound to arise. One is being worked on now in the plant which cools and washes the hot gases from the oil burners with seawater—a combination which has been eating through the walls of the plant in months. There may also be some replacement of metals which are apparently quite satisfactory.

One is being worked on . . .

For example, many ships nowadays go to the shipbreaker's yard with the original tubes in their condensers. But the design of these condensers was governed by the materials that were available to the designer. He wanted long life: he got it with heavy tubes, low water speeds and a big condenser: the condensers on a transatlantic liner are together as large as a house. Suppose you were tackling the problem of a marine condenser from scratch. Suppose you could use all that space profitably for passengers or cargo. Would you not think of a titanium condenser using a high water speed and a thin gauge material, in a form perhaps more like a motor car radiator than the conventional great bank of tubes?

That is just the sort of challenge that titanium is now presenting to engineers. Here is a new metal, freely available for the first time; a metal with a completely new combination of properties, some of them unobtainable elsewhere; an expensive metal which may be very economical to use if you look at your problem with an eye to these new properties; the metal of tomorrow . . . for those who think about using it today.

*The price of I.C.I. raw titanium metal was recently reduced by 10%, making it the cheapest in the world.



Garden Notes

By Philip Harvey

The mild, wet autumn of 1956 encouraged a considerable number of soft, sappy shoots on rose trees generally. Many will have failed to ripen properly before the onset of winter, and it is essential to cut out all this unripe wood when pruning. I am writing these notes in late December, and by early March it is probable that we shall experience hard, continuous frost, resulting in die-back. Frosted growths are relatively easy to detect (the unripe shoots naturally succumb more readily to extreme cold), but if there are no really severe frosts you must take great care to check your trees so that every unripe growth is spotted and subsequently removed.

I have stressed this business of eliminating unripe wood because it is more than half the battle when pruning. In other words, whether you eventually prune hard, medium or light (and there is no cast iron rule regarding the actual *degree* of pruning), the first task is to dispense with all useless growth. Unripe shoots do often grow on and produce blooms, but they subsequently die. If frosted, they usually fail to flower and may well show various markings and discolorations plus die-back.

I am afraid that many gardeners are unadventurous when it comes to Michaelmas daisies. These plants have been improved out of all recognition during the last twenty years, and there is really no excuse for retaining the older varieties which were so often straggly in growth and had relatively small, muddy-coloured flowers. Some of these old-timers increased too quickly, so that within a year of planting one was faced with a weedy clump.

The newer varieties are slower of increase but are still quite generous, so that an initial outlay of 5s. or 3s. 6d. for one of the latest kinds will soon be repaid by at least six specimens, assuming you lift and divide the following spring.

Before discussing varieties, a word is necessary regarding cultivation. Choose a sunny or slightly shaded position and remember that these plants dislike dryness at the roots, which encourages mildew. A fungicide such as 'Spersul' or 'Tulisan' will keep this disease at bay, but on light, sandy soils it is always advisable to work in plenty of compost, damp peat, etc., when planting and to mulch during a summer drought. In my experience they do rather better on heavy soil, as this type of land is generally more retentive of moisture.

The finest flowers are obtained by dividing the clumps annually. In any case division is desirable every two or three years to avoid small, inferior blooms; thinning excess shoots does help, but it is far better to replant the outer pieces from each clump.

My favourite varieties include Crimson Brocade, which holds its colour exceptionally well (3 ft.); Ernest Ballard, a brilliant rose-carmine with unusually large blooms about 3 in. in diameter (3 ft.); Janet McMullen, a delightful rose-pink which seems equally good in both dry and wet summers ($3\frac{1}{2}$ ft.); Ada Ballard, a lavender-blue with fully double blooms (3 ft.); Moderator, violet-purple, again fully double (3 ft.); and Sexton, a rich blue (4 ft.). Blandie is a first-rate white ($3\frac{1}{2}$ ft.). All these varieties require staking (another reason for getting rid of superfluous shoots).

March is, of course, a very important month for sowing vegetable seeds, but remember to go by the condition of your soil rather than the calendar. Broad beans, Brussels sprouts, lettuce, leeks, onions, parsnips, parsley, peas, radishes, spinach and summer cabbages can all be sown. Many gardeners blame the seedsman for poor germination, but this can often be traced to attacks by soil-borne fungus diseases, such as seed decay and damping off, which occur *before* the plants appear above ground.

By using a seed dressing such as 'Seed-Saver,' especially on peas and beans, which rot off so easily in the soil, you will secure a more vigorous crop and in the end a heavier yield, particularly under poor growing conditions.

How about flowers? 'Seed-Saver' is unquestionably beneficial to many species but some may be adversely affected, and I would suggest dressing a trial quantity of any particular variety before sowing.

If you contemplate sowing a new lawn this year, disregard the oft-repeated advice to sow in spring. Early September in the south and late August in the north are preferable, as the soil is warmer and weed competition is often less severe. Most important of all, a prolonged dry spell which frequently delays growth in spring or even causes the seedlings to dry up (especially on light sandy soils) is extremely unlikely.

Sweet peas can be grown on the same plot of ground year after year provided the soil is prepared really thoroughly to a depth of one spit (for cordon culture soil preparation must extend to not less than 16 in.). Compost, hop manure, leaf mould, damp peat and similar materials, plus bonemeal to stimulate vigorous root action, should be well mixed with the soil.

The old-fashioned idea of sowing in double rows about 1 ft. apart still holds good. Individual seeds are best set 3 in. apart to avoid overcrowding.

Ten Days in Mexico

By Douglas Allan

The modern Mexican's Indian ancestry is a source of pride to him, and just outside Mexico City are reminders of this ancestry—the vast pyramids and ruined cities of the Toltec and Aztec civilisations.

Photographs by L. W. G. Drayton (Alkali Division)

One can see only a small part and yet a great deal of Mexico in a visit lasting ten days. It is, of course, a larger country than most of us appreciate from a cursory glance at a map—eight times the area of the United Kingdom and predominantly mountains and plateaux. To travel the length and breadth of the country and absorb all there is to see would require as many months as we had days, and in the circumstances it was perhaps fortunate that the business which took us there limited our travels to not far from Mexico City.

Mexico City does not conform to the Mexico of one's imagination as do smaller towns such as Taxco in the State of Guerro. There the Spanish influence is so marked that it is difficult to believe that it is anywhere but in Spain. The town clings to a hillside, red-tiled houses rising tier upon tier with steep, narrow cobbled streets between. There is little that is modern, and the monotonous drums and brass of the village band at the inevitable *feria* and the peon lying in the shade sleeping off the *pulque* are all in character.

On the other hand, Mexico City has that rather anonymous look which characterises most large cities. A solitary skyscraper which sticks up like a pencil, rows of office blocks, shops and hotels—these are the commonplaces of great cities; but for all that it would be wrong to give the impression that it lacks character.

It is a city of great architectural contrast. At one extreme is the Zocalo, a great square in the centre of the city, flanked by the cathedral and the President's Palace, the latter a particularly fine example of the Spanish colonial style. At the other, the university, conceived on the American pattern, as one might expect, but executed in Mexican fashion. Over the campus are grouped long, low buildings and tall, narrow ones, severely modern in their rectilinear form but with entire walls given over to gigantic murals, mosaics in natural stone, embodying the traditional designs and conventions of the Aztecs. To our eyes the association seems strange, even garish, but in the strong sunlight strangely appropriate to its setting.

It is in its surroundings that Mexico City can claim its greatest distinction.

From any point of vantage, such as the university, one cannot fail to be impressed by the panorama of the city sprawled out across the valley, looking even larger than its three million population would warrant. On all sides rise the mountains which surround it, so that one cannot leave the valley without crossing them, and away to the east even they are dwarfed by the snow-covered volcanic peaks of Popocatepetl and Ixtaccihuatl.

Such is the effect of these great mountains that one tends to forget that the floor of the valley is itself at an altitude of just under 8000 ft. until reminded by the breathlessness which follows any rash exertion. The effect of being suddenly deposited at this altitude after a journey by air varies from person to person, but it generally takes a day or so to become accustomed to it.

Basilica of Santa Maria at Ocotlam, *60 miles from Mexico City. The inhabitants of the State of Tlaxcala, in which Ocotlam lies, were allies of the Spanish invader Cortes.*

Main street in Curnavaca. *This small town 50 miles from Mexico City is a week-end resort for wealthy Mexicans.*

The centre of the present city stands on the site of Tenochtitlan, the capital city of the Aztecs. When Cortes, the Spanish conqueror of Mexico, arrived there, he saw a city, not of streets but of canals, of footpaths and of bridges, without approaches other than by causeway or by boat.

The Aztecs, although by far the best known to us because of their conflict with Cortes, were only one of several Indian nations inhabiting central Mexico. They occupied a restricted area, and most of the scene of Aztec history can be covered in a day's car journey from Mexico City. Their civilisation endured for little more than 400 years, from about 1100 to its destruction by Cortes in 1520.

Hated by neighbouring peoples because of their cruel and warlike habits and defeated by them in battle, the early Aztecs took refuge on islands in the lakes which then covered a great part of the valley of Mexico. They grew crops on *chinampas*, artificial islands created on the shallow lake by scooping mud from the bottom into wicker frames, which retained the soil until it was bound firmly by the roots of the vegetation which they planted. As the city grew, the first *chinampas* were used as the foundations for fresh buildings and new *chinampas* were created, and in this fashion the system of buildings and waterways which so impressed Cortes and his followers was created.

There is much to be seen immediately outside the

Dressing churches with flowers *is a country custom in Mexico. A more savage custom was enacted by the Aztecs near here when they ushered in each new century by lighting a fire on the chest of a newly killed sacrificial victim.*

Rivalling the Pyramids *of Egypt, the Pyramid of the Sun at San Juan de Teotihuacan is thought to have been built by the Toltecs in about A.D.* 800

city. To the south, *chinampas* are still being worked at Xochimilco just as they were in Aztec times, while to the north, at San Juan de Teotihuacan, stand the greatest of all the surviving monuments of the Indian civilisations.

It appears that here an area three miles long by two miles wide was covered with imposing building devoted to religious activity. Many of these now appear as little more than humps on the ground, but three great structures remain.

By far the largest of these is the great stepped Pyramid of the Sun, rivalling, if not bigger than, any of the pyramids of Egypt. To its north is the Pyramid of the Moon, smaller but still huge, and to its south the great rectangular walled enclosure of the Temple of Quetzalcoatl. The age of these structures or who built them is not known with certainty, but they are commonly attributed to the Toltecs, predecessors of the Aztecs, and said to date from about A.D. 800. The site appears to have been abandoned about the tenth

Ruins of a city *at Monte Alban, near Oaxaca, dating from the Zapotec and Mixtec civilisations. In tombs here was found treasure buried with members of the royal dynasty.*

or eleventh century, and was never reoccupied by the Aztecs.

Whereas the Egyptian pyramids were built as tombs, as monuments to the dead and to protect their bodies, those at Teotihuacan were very much for the use of the living. They were the scenes of great religious festivals and ceremonies, and on the steps and on the summit of the pyramids stood the altars where victims were sacrificed to honour and appease the gods.

It is strange indeed that the Aztecs never made use of the amenities of Teotihuacan, for they, more than any others, appear to have been devotees of the sacrifice cult. It is alleged that Montezuma on one occasion sacrificed 12,000 captives from Oaxaca in honour of his war god.

This, then, is some account of what is to be seen in and around Mexico City. What of the modern Mexican? To what extent can one see the ancient Aztec in him?

The answer seems to be very much so. Racially the Mexicans are predominantly Indian—it is said 90%—and they are justly proud of it. They regard themselves not as white or coloured, but as an Indian nation.

The Spanish influence, at one time so great, is diminishing, and it is the result of deliberate acts of policy that real power in the republic rests in Indian hands. The country has emerged from a long and often turbulent period of its history, shaking off Spanish and French domination, and surviving uneasy and, on occasion, openly hostile relations with the United States.

It is still a country of much poverty. For those who like to measure such things, the per capita income is about one-tenth that of the United States, these days the accepted standard of material wealth. Nevertheless industrialisation is proceeding apace, and it seems beyond doubt that Mexico, given a continuance of stable government, can look forward to more prosperity.

NEWS IN PICTURES

New office buildings *for some departments of General Chemicals are to be built at Runcorn on part of a newly acquired 30 acres. Picture shows proposed design by Mr. Frederick Gibberd, who was architect for London Airport's new terminal buildings*

Largest reunion *of pensioners ever held in Metals Division took place in Oscott Hall, Witton. The pensioners numbered 580, and ranged in age from 92-year-old Mr. S. Nutt to "youngsters" who have just retired. Dinner was followed by two hours of entertainment*

Condenser tubes *of I.C.I. titanium, first ever used in a British power station, are seen here being installed at Uskmouth power station, Newport, Monmouthshire, for corrosion trials. I.C.I. titanium is also used in the Bristol "Britannias" just brought into service by B.O.A.C.*

Big squeeze *on a Yorkshire road was caused by nitric acid absorption tower on its way to Wilton's new nylon works from Stockton. 131 ft. long and weighing 93 tons, the tower took 2½ days to make the journey, sometimes needed three tractors to haul it*

Robin Hood's Bay, *Yorkshire, where a new search for natural gas is being undertaken by I.C.I. and B.P. Exploration Co. Ltd. As a first step a borehole drilled here for potash is being deepened to penetrate limestone formations several hundred feet below*

His best friends *would not know him, but the frogman with his arm on the Li-lo is Mr. J. Chappell of Fibres Division Technical Service Department, about to start a $4\frac{1}{2}$-mile "snorkel" trip up the River Ure with fellow members of a Yorkshire underwater club*

Fastest motor-cycle. *This 650 c.c. Triumph "Thunderbird," equipped with two type GP carburetters made by I.C.I. subsidiary Amal Ltd., is current holder of the world maximum speed record of $214\frac{1}{2}$ m.p.h.*

Eight Hungarian refugees *are now working at Wilton. With the help of Mr. L. Kardakuty, a 'Terylene' worker who came to England in 1948, they have been learning English phrases, weights and measures*

Hoisting the flag *at Wilton polythene works to celebrate $\frac{1}{2}$ million accident-free man-hours is works manager Mr. L. P. Bayly. Flag, showing Brunner-Mond crescent and molecular structure of polythene, was specially designed as works' own house flag*

To help amateurs *choose right paint for the job and to explain right way to apply it, Paints Division have published this booklet, available from all retailers of I.C.I. paints*

Darby and Joan clubs *of Islington were given a party paid for by Christmas collection at Head Office. Top: Mr. D. G. Marsh of Stock and Share Dept. entertains guests with impersonation. Below: Mr. C. Wilson and Miss L. Hirst of H.O. and Regions Staff Dept. with 82-year-old Mr. Walter Hadden*

Ten years ago *nylon was first spun at the Pontypool plant of British Nylon Spinners, joint I.C.I.-Courtaulds company. Latest achievement of the plant is nine-denier yarn for stockings, five times finer than a human hair*

Cameras *went down a coal-mine to record scenes for Nobel Division film on pulsed infusion shotfiring, a new technique which uses water to spread force of explosion. Picture shows Mr. Peter Grimwood, I.C.I. Film Unit cameraman, filming scene in Vane Tempest mine, Co. Durham*

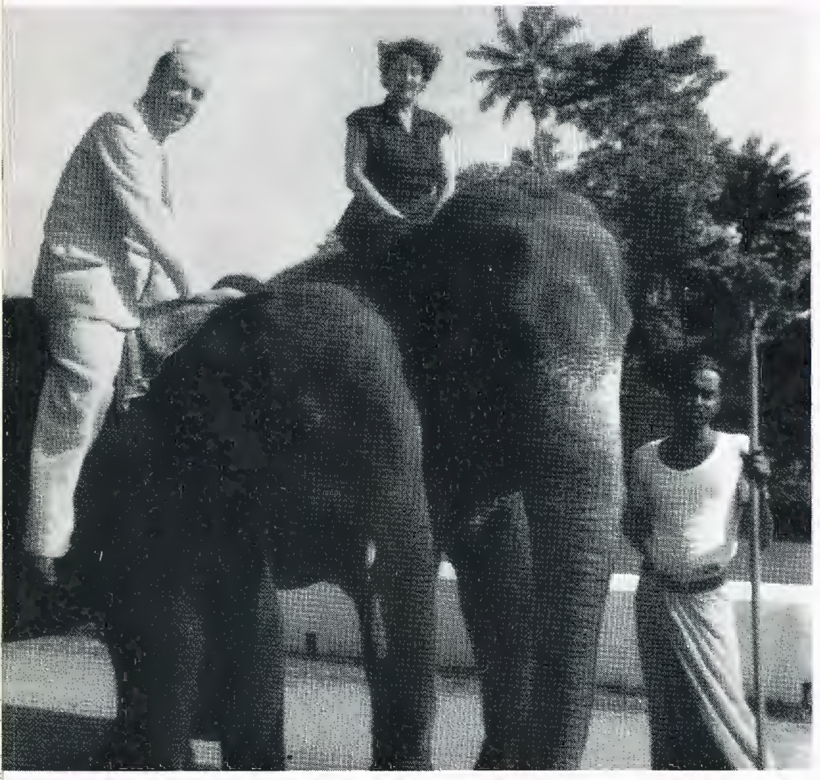
PICTURES FROM OVERSEAS

France. *A recent view of the plant at Petit-Quevilly, near Rouen, Normandy, of Fermeture Eclair the French 'Lightning' Fastener subsidiary. The firm also manufactures flexible fuel tanks, radomes and aerial housings under licence from Marston Excelsior Ltd. and employs nearly 1000 men and women.*

Canada. *Fork-lift truck drivers at the Montreal Works of C.I.L. Paints Division merely push a button when they want to open warehouse doors. Small transmitters on the trucks are tuned to receivers on the doors. The system saves time and eliminates draughts*

India. *"The Roundel," house magazine of I.C.I. (India), was recently judged the best-printed house magazine in India by Ministry of Information and Broadcasting. Editor is Jennie Barrell, printers are Sree Saraswaty Press Ltd. of Calcutta*

Canada. *Talking with a sergeant of the "Mounties" and a constable of Toronto Police is Mr. D. Learment, C.I.L.'s Toronto district manager for ammunition. C.I.L. have recently introduced two new cartridges for police revolvers*



Ceylon. *I.C.I. Overseas Director, Mr. E. A. Bingen, and Mrs. Bingen were photographed (above) at Kandy, the old hill capital of Ceylon, during a brief tour of the country on the way home from India in January*

Australia. *Clad in immaculate trousers and shirt, spear-fishing expert Noel McLeland entered Brisbane harbour to test claims made for 'Terylene'; surfacing with a fish, the creases in his 'Terylene' trousers remained perfect*

U.S.A. *Mr. H. S. MacLean (left), a director of I.C.I. (New York) and president emeritus of the British Schools and Universities Club of New York, receives a resolution announcing a fund for scholarships for Scottish students in American Universities*

Pakistan. *At the Karachi Caledonian Society's ball guests of honour were the President of Pakistan and the Begum, seen here with Mr. W. E. Wilkie-Brown (chairman of I.C.I. (Pakistan) and chieftain of the society) and Mrs. Wilkie-Brown*

I.C.I. NEWS

FOUR NEW DIRECTORS

Four new I.C.I. directors have been appointed: Dr. R. Beeching, Dr. J. Ferguson, Mr. L. H. Williams and Mr. C. M. Wright.

The new appointments link up with other Board changes as follows:

Economic Planning Director. Mr. J. L. S. Steel has relinquished his appointment as Group A Director and has been appointed to the newly established position of Economic Planning Director.

Group A (Heavy Chemicals) Director. Mr. C. Paine in succession to Mr. J. L. S. Steel.

Development Director. Mr. C. M. Wright in succession to Mr. C. Paine.

Research Director. Dr. J. Ferguson in succession to Dr. R. Holroyd.

Technical Director. Dr. R. Beeching in succession to Sir Ewart Smith.

Group B (Dyestuffs and Pharmaceuticals) Director. Mr. L. H. Williams (from 1st April) in succession to Mr. P. K. Standring, who will retire on 31st March.

Dr. R. Beeching, who is 53, joined I.C.I. in 1948 and in 1951 became a member of the 'Terylene' Council. In 1952 he went to Canada and the following year was appointed a vice-president of I.C.I. (Canada) Ltd. with special responsibility for 'Terylene' development. Since 1955 he has been chairman of Metals Division.

Dr. J. Ferguson, who is 57, joined Billingham Division as a research chemist in 1928. In 1931 he moved to General Chemicals Division and from 1935 until 1939 was actively engaged in shadow factory work. After a period with the Ministry of Supply in 1941 he returned to I.C.I. and for seven years was Research Manager and a director of Alkali Division, and from 1950 until 1951 held the same positions in the General Chemicals Division. In 1951 he became Joint Managing Director of General Chemicals Division.

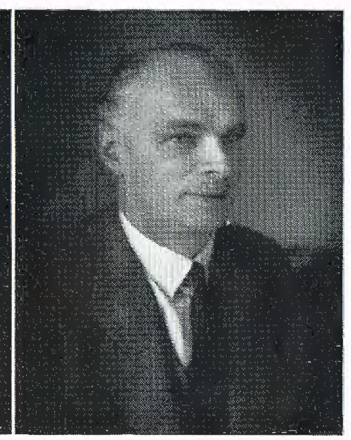
Mr. L. H. Williams, who is 54, has spent all his career in I.C.I. with the Paints Division or its constituent companies. In 1929 be became Plant Superintendent of Naylor Bros., Slough, and successively Assistant Works Manager, Works Manager, Development Manager, Division Director, Division Managing Director, and, in 1949, Division Chairman.

Mr. C. M. Wright, who is 52, joined Synthetic Ammonia and Nitrates Ltd., Billingham, in 1927. Until 1941 he was engaged in research or in the works of ammonia, methanol and 'Drikold.' In 1942 he was appointed Prudhoe Works Manager, and after a period as Gas and Power Works Manager he was appointed Works General Manager. Mr. Wright became Personnel Director of the Billingham Division in 1952 and chairman of Wilton Council two years later.

Dr. R. Beeching

Dr. J. Ferguson

Mr. L. H. Williams



Mr. C. M. Wright

CHAIRMAN'S MISHAP

While sightseeing in the Ajanta caves at Aurangabad, Bombay State, India, on 8th February Sir Alexander Fleck slipped and fractured a leg. He had been in India only a few days, on a tour that was to have included many of I.C.I. (India)'s factories and offices. He was later to have gone on to Malaya and Hong Kong, returning to this country at the end of March.

Sir Alexander was taken to hospital in Bombay and was later stated to be fairly comfortable. At the time of going to press he was still in Bombay but was to be flown back to England as soon as his condition allowed.

On behalf of our readers we offer Sir Alexander our best wishes for a speedy recovery.

DR. M. P. APPLEBEY

We regret to record the death on 7th January of Dr. M. P. Applebey, who was Research Director of Billingham Division until his retirement in 1946.

Mr. P. A. Smith, chairman of Pharmaceuticals Division, writes:

The death of Malcolm Percival Applebey revives happy memories of Oxford in 1919 and after. Applebey was then Fereday fellow of St. John's, university lecturer in chemistry and college tutor of several men who later achieved various degrees of distinction on the staff of I.C.I.

His lectures on inorganic chemistry were models of lucid exposition, and his researches with the Earl of Berkeley on osmotic pressure were precise and skilful. To him education was a social occasion as well as a scholastic exercise. He and his colleagues in St. John's provided the medium which, from the 1919 vintage, produced two political peerages, a dominion foreign minister, two lions of the stage, the chairman of Woolworth's, two directors of I.C.I., and professors in plenty.

It was in college that his endearing personality flowered. A tutorial with him, blessed with the fragrance of his numerous if insanitary pipes, was a liberal experience in itself. College affairs, from the river and the field to the Essay Society and King Charles Club, were his lively concern. All of us who knew this generous clubbable man will remember him with gratitude and affection. He taught the senators wisdom.

HEAD OFFICE

Overseas Controller Retires

Mr. S. P. Leigh, Overseas Controller, retired on 31st January after 36 years' service. He is succeeded as Overseas Controller and as chairman of I.C.I. (Export) Ltd. by Mr. E. J. Langford.

An appreciation of Mr. Leigh will appear in our next issue.

ALKALI DIVISION

Hungarians at Wallerscote

Eleven Hungarian refugees began new jobs and a new life on 7th January when they joined the payroll at Wallerscote Works.

They are at present housed at Marbury Hostel, where some 200 Polish and British employees of the Division's mid-Cheshire works live.

None of them could speak English when they arrived in this country by air from Austria. Now, with English lessons three evenings a week at the hostel, they are learning quickly.

Through an interpreter—a lady who is Hungarian by birth and lives locally—they were anxious to convey to the British people how happy they were to be in England; how they appreciated the kindness of I.C.I. in giving them this opportunity to work, and above all the friendly way in which they had been received by the men with whom they are working at Wallerscote.

BILLINGHAM DIVISION

New Antioxidant Plant

Work has started on the construction at Billingham Oil Works of a new plant designed to produce a further 1600 tons a year of 'Topanol' O, an antioxidant used to improve petrols and lubricating oils. When it is in operation in 1958 I.C.I. will be one of the world's largest producers of antioxidants.

'Topanol' O was the third antioxidant to go into quantity production at Billingham—the others are 'Topanol' A and 'Topanol' M. It is made from a special tar-acid fraction.

The present plant is producing a substantial part of the United Kingdom requirement, and construction of the new plant forms part of the Company's drive for additional exports. The new plant has been designed at Billingham by members of Technical Department and Engineering Department and will be built by Engineering Works.

Antioxidants are among the many additives which are put in very small quantities into motor and aviation petrols; if they are not used, oxygen in the atmosphere causes the formation in the fuel of gummy deposits. These deposits begin to form as soon as the petrol comes into contact with air and settle in carburettors, on valves and in other engine parts, resulting in loss of efficiency and power.

Uses for antioxidants are being discovered and investigated in many other industries also. It is thought that they will have wide applications in the field of plastics, and their use is already being assessed in natural and synthetic rubber, both of which are affected by surface cracking as a result of attack by oxygen or ozone.

In the United States and Canada the public health authorities have approved the use of certain antioxidants to improve the keeping qualities of foodstuffs.

Competition in fertilizer markets

A warning of further competition in fertilizer markets was given to members of the Ammonia Section of Billingham Ammonia Works by Dr. S. W. Saunders, Division Technical Managing Director.

He was speaking at a dinner given to the section to celebrate last year's record production of ammonia, which was about 50 tons a day more than ever before.

Dr. Saunders referred to oil company plans to go into ammonia and fertilizer production. He said that gas produced in oil-refining operations had a lot of hydrogen in it, and under certain conditions it might become worth while to make ammonia from it. One oil company was putting up a plant on the Thames to make 250 tons of ammonia a day.

Dr. Saunders forecast, however, that after a period in which increased supply would exceed demand, the steadily rising use of nitrogen fertilizers would lead to a balance. "We are quite certain we can hold our own," said Dr. Saunders.

DYESTUFFS DIVISION

Off to the Himalayas

Mr. E. W. Dance, a research laboratory assistant in the resins section of the Division's Research Department, has been granted leave of absence to join the Manchester Himalayan Expedition.

Mr. E. W. Dance

The expedition, which is expected to leave England at the end of April, has the backing of the Everest Foundation and of the *Manchester Guardian*. It was initiated by the Rucksack Club, but includes leading Manchester climbers not in the club.

After a short period of acclimatisation, the expedition hopes to start serious climbing in June. Their first objectives will be Masherbrum (25,660 ft.) and Saltoro Kangri (25,400 ft.) in the Karakoram range of mountains in Kashmir. Masherbrum has been attempted twice and Saltoro Kangri once. The climbers also hope to reconnoitre the little-known glaciers south of Masherbrum.

Mr. Dance's special duty will be to obtain and organise food for the party of six. Aged 29, he has been a keen walker since his schooldays, and started climbing when he joined the Manchester University Mountaineering Club. He has climbed widely in Great Britain and has five years' experience of Alpine climbing around Zermatt and Chamonix.

As guide editor of the Manchester University Mountaineering Club, Mr. Dance wrote their climbing guide to the Cwellyn area of North Wales. He is now president of the M.U.M.C., and a member of the Rucksack Club committee.

GENERAL CHEMICALS DIVISION

Lord Roberts' Day

Next month one of I.C.I.'s oldest companies celebrates the golden jubilee of I.C.I.'s oldest rifle club. In 1906 the works manager of Chance and Hunt, W. A. S. Calder, conceived the idea of forming a rifle club, and on 4th April of the following year the ranges were formally opened by Field-Marshal Lord Roberts, V.C. Since then the Rifle Club has maintained a continuous line of shooting men—and a few women—over a period spanning three generations.

Nothing world-shaking has emerged, no records have been broken, and the only international shot produced has been R. D. Smith. Nevertheless, in terms of solid, worth-while enjoyment and, perhaps even more, of heart-warming good fellowship a tradition has been set up that is well worth preserving. In its relations with other clubs the Chance and Hunt reputation for good sportsmanship stands high, while for willing service in the cause of rifle shooting its record is enviable.

Lord Roberts (sixth from right) at the opening of the Chance and Hunt rifle range in 1907

The Chance and Hunt Rifle Club has, incidentally, contributed to local tradition. Lord Roberts' visit was such a red-letter day for Oldbury that the managing director of the time, Alexander M. Chance, decided to perpetuate the occasion by having the bells of the parish church rung on each succeeding anniversary. He provided the necessary funds, and to this day the bells ring out on 4th April.

METALS DIVISION

Gold Watch for Zipp Werk Manager

Mr. Hans Braun, General Manager of Zipp Werk G.m.b.H., received a gold watch from Sir Alexander Fleck recently when the Chairman visited Metals Division at Witton.

The presentation was in recognition of Mr. Hans Braun's 30 years' service. He joined Kynoch's Deutsche Amacvergaser und Apparatebau G.m.b.H. in 1926, the year a fastener unit was started in Nuremberg. This unit, which has been called the cradle of the German fastener industry, later became I.C.I.'s subsidiary company Zipp Werk G.m.b.H. Mr. Braun was appointed head of the Accountancy and Costing Sections in 1931, a position he held during the important formative years.

During the war he remained with the Company and continued, despite many difficulties, to run the departments under his control efficiently. After the war he was appointed Commercial Manager, and when Mr. Brunthaler, then General Manager, retired in 1951 and was succeeded by Mr. F. A. Payne, Mr. Braun was appointed Deputy General Manager. On the appointment of Mr. Payne to Lightning Fasteners Ltd. in 1955 Mr. Braun became General Manager, heading what is today Germany's largest and still expanding fastener factory.

Mr. Hans Braun (holding watch) with a group of his friends at Witton

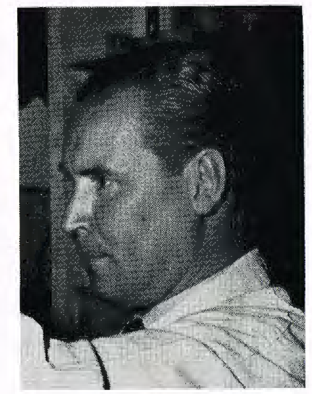
STILL CLIMBING

The readership of the *Magazine* continues to grow. Last month 81,000 copies were printed —1000 more than a year ago and 18,000 more than five years ago.

I.C.I.A.N.Z.

Helpful Immigrant

Helping immigrants to Australia to overcome the difficulties of making their homes in a new land is the main spare-time interest of Mr. Otto Wilms, a laboratory assistant at Yarraville Factory.



Mr. Otto Wilms

It is this interest in helping others with problems which he himself had to face when he migrated from Hamburg, Germany, three years ago, that in January carried Mr. Wilms to Canberra to attend the Australian Citizenship Convention—an annual four-day conference sponsored by the Commonwealth Department of Immigration.

Mr. Wilms was one of five non-British migrants selected as members of Victoria's twelve-man delegation.

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OUR NEXT ISSUE

"The Way Ahead" is the title of an article by P. C. Allen, Fibres Group Director, which leads our April issue. Mr. Allen sketches two probable lines of advance in industry—the efforts now being made to shorten the development stage of new projects, in particular by the use of models; and the gradual blurring of the old lines of division between staff and payroll workers.

Then come three features, all illustrated in colour: an article by B. R. Goodfellow, known to many readers as a keen Alpine and Himalayan climber, on the pleasures of a holiday in Skye; a delightful reminiscence of the old days in China by R. J. Sheppard, head of our Hong Kong office; and a colourful account of a lazy sunny day beside the sea in Greece, written rather in the Hemingway style by W. C. McDowall of Nobel Division, runner-up in the Holiday Competition.

The Smoke in Hiawatha

By John Watney

WHENEVER I am asked to take part in amateur theatricals—which is not, I am glad to say, very often—I invariably reply: "I have never been on the stage." This is not strictly true; for I did take part once, at the age of eleven, in a school production. I was the smoke in Hiawatha.

Every year we used to put on a play written by the headmaster, Major Thorp. It was a burlesque of army life when he was a young subaltern; and it was a comparatively simple matter to adapt the simple jokes, mostly about discipline, from the military to the scholastic level. It was immensely popular.

And then one day Major Thorp, dressed in his Norfolk jacket and knickerbockers, said in a voice that was not as vigorous and commanding as usual: "We're not going to put on my old play this year. We're going to be very ambitious indeed; we're going to put on . . ." he took a defensive step backwards and stared challengingly at us ". . . Hiawatha!" No one said a word.

"Hiawatha," continued Major Thorp, in a voice designed perhaps to convince himself as much as us, "is a very fine epic poem by the great American poet Longfellow, which some of the seniors will know from last term's studies." We of the middle school looked anxiously at the seniors, but from their glum expressions it was obvious that this was no commendation.

"It's all about Red Indians," said Major Thorp rather desperately, "so there will be plenty of opportunity for dressing up." Even this piece of encouraging information could not dispel the general feeling of alarm. "And I shall expect," continued the major, recovering his confidence, "that the school will, as usual, put its very best into this production, which will be in the very capable hands of Mr. Hedleigh-Smith."

Hedleigh-Smith, our young and progressive English master, was standing with the rest of the staff behind the headmaster. He went bright red in the face, then looked first modestly down at his feet and then belligerently up at us. "File on!" said Major Thorp before anyone could think of anything to say; and obediently we turned to the right and marched, as we did every day, in single file to the dining room.

Hedleigh-Smith himself addressed the school next day. "My idea," he told us in the high-pitched voice of the amateur fanatic, "is to present four of the books of *The Song of Hiawatha*, mainly in charade and mime, while a chorus of twelve boys will recite the appropriate lines. The books I have selected for presentation are Book III, "Hiawatha's Childhood"; Book X, "Hiawatha's Wooing"; Book XIX, "The Ghosts"; and Book XX, "The Famine." Volunteers who wish to take part in the play will meet in my study at five o'clock this evening."

This put most of the would-be actors in a quandary. Usually there was no lack of volunteers, not because it gave a chance of acting ability but because of the privileges attached to the venture: there were tea-parties and outings, rehearsals instead of prep, and that feeling of importance that amateur theatricals always give to those taking part in them.

But Hiawatha, from the few glimpses most of the boys had had, was a different matter. It was poetry; there was a great deal of it, and there did not seem to be any action. There was not, therefore, much enthusiasm for the production.

I was quite happy about this, for it had always been my ambition to act in the school play; but so far, although I had volunteered on every occasion, I had never landed a part. Either my voice was too high or my interpretation of the lines was not in agreement with that of the producer. Once I almost got a part but dried up at the first rehearsal, and was replaced by a bumptious boy called Billing. Here, at last, was my big chance.

"Now, chaps," said Hedleigh-Smith, who believed in treating us as his equals, "here's the plot: Hiawatha's mater died when he was an infant [even the masters referred to parents, as we did, by the Latin derivative], so the little fellow is being brought up by his grandmother, old Nokomis—fine part there for a budding character actor—who teaches him forest and folk lore. Then along comes Iagoo, the great boaster—a good part there for you, Billing!" This sally was greeted with laughter, for Billing, who was large as well as bumptious and had a father who was a financier, was always boasting of his family's achievements.

"At Iagoo's instigation, Hiawatha goes out into the forest and shoots his first red deer. And that," said Hedleigh-Smith, much to our surprise, "is the end of Book III."

"No cowboys?" asked Fraser, a small tough Scots boy who had, it was known, the finest collection of Wild West stories in the school.

"No cowboys," replied Hedleigh-Smith with some disapproval.

Fraser walked out of the cast immediately; and Hedleigh-Smith, fearing perhaps that the rest of us might follow suit, hurried on: "There is more excitement later on. In Book X we have Hiawatha's marriage with Minnehaha, Laughing Water, daughter of the ancient Arrow Maker. We'll stage a great feast with the warriors dressed in their finest feathers doing a fierce war-dance." This slight departure from the spirit of the text sounded more promising. We all knew how to imitate the Indian war-cries to perfection.

"Book XIX tells the strange story of how the ghosts of past warriors come to the Indian camp and instruct the living in proper burial rights; while Book XX deals with the Great Famine, the death of Minnehaha and, although it is really in Book XXII, Hiawatha's departure—a fitting close to the epic."

The recital of these gloomy events raised our spirits somewhat; ghosts meant dressing up in white sheets; while the Famine Scene would obviously call for indrawn cheeks, rolling eyes, yowls of dismay, and beating empty plates with spoons.

There was by now quite an enthusiastic response to the call for volunteers. The captain of the school got the lead as Hiawatha; a young French boy called du Passe who had black eyes and curly hair and always took female roles was cast as Minnehaha, while Billing, thick-skinned as ever, gladly accepted the part of Iagoo. The rest were allotted roles as braves, warriors, squaws and witch-doctors. Only I was left out.

"We'll find something for you, old chap," said Hedleigh-Smith; "don't you worry." It was not, however, until the dress rehearsal, the day before the show, that I got my big chance. Hedleigh-Smith was placing Nokomis, Minnehaha and attendant warriors for the opening of the Ghost Scene when he said quite suddenly: "What we need is smoke!"

"Why smoke, sir?" asked wrinkled old Nokomis.

"Because it says so in the text, old chap." Hedleigh-Smith folded back his copy of Hiawatha and read out:

And the smoke in wreaths about them
Climbed and crowded through the smoke-flue.

He stared at the backdrop of painted wigwams, pine trees and blue glass that was supposed to represent Gitche Gumee, Big Sea-Water, and said "We can drill a hole at the apex of the wigwam, and one of you splendid little chaps can puff smoke through the hole when we come to those lines." He looked hopefully at the squatting warriors, and, receiving no encouragement, turned to me and said: "I think we've found a home for you at last."

He made a hole above the wigwam, and then, taking me backstage, placed a wooden crate against the backcloth and said: "Hop up there, and let's test for height." The hole came to the level of my nose. "That's fine!" he said. "Now I'll get your impedimenta, old chap."

He returned in about ten minutes with one of his pipes, much chewed at the stem, a box of matches and a tin of Christmas Party Joke Smoke, which, according to the instructions inside, was guaranteed to keep any child in fits of laughter by the simple process of putting a capsule on a plate, lighting it, and watching the smoke curl up to the ceiling.

"Now listen, old chap," said Hedleigh-Smith. "Your cue is:

One dark evening, after sundown,
In her wigwam, Laughing Water
Sat with old Nokomis, waiting
For the steps of Hiawatha
Homeward from the hunt returning.

"As soon as those lines begin, you'll pop one of the capsules into the pipe, light it, and as soon as the smoke is thick enough, place the bowl against the hole in the backcloth and then puff like billy-ho down the stem. Got it?"

"Yes," I replied, trembling with excitement.

"Right, we'll just run through it, then. We want to get it right first time, because there are not many capsules left and we haven't time to get any more."

There were exactly three capsules, and I stood on

my crate, my ear pressed to the hole in the backcloth, waiting for my cue. As soon as the opening words came through the hessian I crouched down on the crate, put a capsule in the pipe, struck a match, lit the capsule, stood up, and twisting the bowl of the pipe to fit over the hole began to puff with all my strength just as the words

And the smoke in wreaths above them
Climbed and crowded through the smoke-flue

came from the high-pitched voices of the chorus on the stage. I was still puffing away, rather red in the face, when Hedleigh-Smith came striding backstage.

"Magnificent!" he said. "Very effective! You can stop now."

The capsule had burnt itself almost out, and I stood looking at Hedleigh-Smith feeling very pleased with myself.

"Tomorrow night," he said, "we'll use two capsules. Give a bigger volume of smoke."

"We won't have any more left then," I pointed out.

"There's only one performance, old chap," he reminded me, "so give it all you've got."

The show was scheduled for four-thirty the following afternoon, and those who were taking part in it were excused games so as to give them time to dress for their parts.

I felt rather envious as I watched, from the top of my crate, the rest of the cast being made up with five and nine greasepaint; but I comforted myself with the thought that although I might not be wearing the fine feathers and Indian clothes that Matron and her staff had so cleverly sewn together I would at least have my moment of triumph when the smoke curled up from the wigwam fire.

Hedleigh-Smith, who looked thin and distraught and spoke in a rather hoarse voice, came up to me just before the curtain went up and said: "All set, old chap?"

I pointed to the pipe, the box of matches and the tin of Joke Smoke beside me. "Yes, sir," I replied.

"Good-ho!" said Hedleigh-Smith, and rushed away mopping his brow.

Although my cue was not due until the third act, I did not dare leave my crate in case the performance was speeded up; and I followed every word on the copy that I had.

At last the words *One dark evening, after sundown* came from the hidden stage, and for a moment the very fact that the long wait was over and that I was expected to play my part paralysed me, and I stood gaping at a totem-pole that had been used in an earlier scene.

"Cue, boy! Cue!" It was Hedleigh-Smith hissing at me from behind the totem-pole; and with trembling fingers I opened the tin of Joke Smoke, put the two capsules into the pipe, lit them and stood up, and with the bowl pressed against the backcloth began to puff.

It was then that things began to go wrong. The smoke from one capsule had been sufficient to curl on to the stage in a steady column; but the double charge now in the pipe could not get through in the same manner. Some of the extra smoke began to flatten against the backcloth and curl round my face; while some more of it forced its way between puffs up the stem and into my mouth.

I began to cough; and as the smoke enveloped me I pressed more and more heavily against the backcloth and puffed with added strength, as much to prevent myself from choking as to get the smoke on to the stage.

And then quite suddenly it happened. At one moment I was wreathed in smoke, and the next moment there was no smoke at all, except for a few faint wisps curling up to the rafters. I was still wondering what had happened when I heard the shouting on the unseen stage, the cry of "Fire!" and "Sand buckets, quick!" and above it the hoarse voice of Hedleigh-Smith shouting "There's no need for anyone to panic; it's only a couple of smoke capsules!" And then I realised that in my agitation I had blown them clean through the backcloth and on to the stage, where they had landed, one on old Nokomis's head and the other in the cradle that Minnehaha, Laughing Water, gently rocked.

"There's no need for anyone to panic; it's only a couple of smoke capsules!"

The capsules were soon smothered with sand, the smoke was cleared from the stage, the actors took up their positions, the chorus set off again with their lines, and the show went on as if nothing had happened. But I remained seated on the crate feeling absolutely miserable, waiting for the condemnation of the rest of the school.

Billing was the first to come off stage, and as he removed his Iagoo headdress he said: "Silly ass, you might have set the school on fire!"

The reaction of most of the other performers was much the same, and Hedleigh-Smith was so angry that he could not say a word to me, but snatched up the pipe, the box of matches and the empty tin of Joke Smoke, stuffed them into his pocket and walked away shouting "On stage for the curtain call!"

I remained on the crate listening to the clapping of the audience as the cast took their calls, and I thought sadly that if it had not been for the mishap I too would have been there bowing to the audience.

As soon as the final curtain fell, the cast, still in their costumes and make-up, went up to Matron's room for a special tea. I was not invited, nor had I the courage to join the rest of the school in the ordinary meal in the main hall. I was still sitting there, wondering whether to run away from school altogether, when I heard footsteps approaching and a voice saying "The little devils have left the lights on again!" and Major Thorp himself came into view. "Hullo," he said. "What are you doing here?"

When I told him what had happened, he said "So you're the culprit" in a rather pleased tone of voice, and then, taking a step towards me and speaking in a conspiratorial whisper, added: "Between you and me, your little effort was the only bright spot in the whole show. Everybody enjoyed it. Reminded them of my own little play. I don't suppose Mr. Hedleigh-Smith will be so keen to put on Hiawatha again, eh?"

And, I am glad to say, we never had Hiawatha again; nor have I ever appeared again on the amateur stage.

Photo by A. Walker (Billingham Division)

"High Force, Middleton in Teesdale"